

THE PREVALENCE OF MANDIBULAR MIDLINE DEVIATION IN CHILDREN AND ADOLESCENTS WITH DIFFERENT TYPES OF MALOCCLUSIONS

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Abstract

In this study, the prevalence of mandibular midline deviation in different types of malocclusions were evaluated taking into account sexual dimorphism in patients with mixed and permanent dentition. With the aforementioned aim, a cross-sectional study was carried out on a total of 214 patients (134 females and 80 males) aged between 7-15 years (with a mean age of 9.5 ± 2 years). On the study casts of each subject participating in the study, the displacement of the lower dental midline compared to the upper one was measured in different classes of malocclusion, taking into account sexual dimorphism. Three study groups were formed: first with mandibular midline deviation with values less than 2 mm, second with deviation between 2-4 mm and third with deviation more than 4 mm. Subsequently, the prevalence of the displacement of the lower dental midline was assessed taking into account the sexual dimorphism and the Angle classes malocclusions analyzed (Angle Class I, II/1, II/2, III) and UPC (unilateral posterior crossbite). Mandibular midline deviation greater than 2 mm was observed in more than three quarters (75.7%) of the patients in the studied group. In the five classes of malocclusion, a higher frequency of displacement of the lower dental midline was appreciated in the range of 2-4 mm of 59.8%. In this interval, the highest percentage of displacement was observed in Angle Class II/1 (18.2%), followed by unilateral posterior crossbite UPC (15%) and Angle Class II/2 (13.1%). Most large displacement of the lower dental midline (with a value more 4 mm) was recorded in unilateral posterior crossbite UPC (5.6%). Although the displacement of the mandibular midline was recorded in a slightly increased percentage in males (61.25%) compared to the group of females (58.95%), from a statistical point of view, no notable differences were reported between the two genders. Dental midline deviation changes should be noted and analyzed from the beginning of orthodontic treatment in order not to cause later functional or aesthetic disorder.

Key words: mandibular midline deviation, prevalence, malocclusion, sexual dimorphism, mandibular asymmetry.

Introduction

The smile is considered to be one of the characteristic features of facial aesthetics, it contributes significantly to the composition

of a harmonious and balanced facial appearance (1,2). An attractive smile also depends of the concordance of the lower and upper dental midlines as well as the concordance of these lines with the facial

midline (3). It was found that inconsistencies greater than 2 mm of these midlines are more likely to be noticed by patients (4,5), while their minor discrepancy can be considered acceptable, not being detectable by them (6,7,8,9).

According to Beyer and Lindauer (1), the aesthetic perception of the deviation of the dental midlines can change unfavorably if other facial structures located on the midline do not coincide with the facial midline of the face, but they did not discover how these facial structures can interfere directly with the perception of the displacement of the lower and upper dental midlines.

The mandibular midline deviation can have a dental, functional (by the occurrence of premature contacts or occlusal interferences) or skeletal cause (as a consequence of defective intermaxillary relations, secondary to disturbances in the growth and development of the maxillary bones) (10,11). We can associate the displacement of the mandibular midline with: inclination or change of position of the lower dental group, with lateral displacement of the mandible without unilateral posterior crossbite, with an asymmetry of the lower dental arch or with unilateral posterior crossbite associated with a displacement of the mandible (12). The diagnostic approach must be meticulous, as these displacements can appear alone or in combinations, influencing the clinical picture of mandibular asymmetry (13,14). Lower dental midline inconsistency can be found in all types of malocclusions and can be associated with disorders of the temporomandibular joint (15,16). Considerable displacement of the mandibular midline can cause changes in occlusion, an unequal transmission of dental forces (17,18), generating facial asymmetry

and consequently having functional repercussions on the temporomandibular joint and features (19).

An adequate understanding of the etiology and the contribution of the triggering factors in the displacement of the mandibular midline is important for the correct planning of orthodontic treatment (20,21).

In order to establish the prevalence of the mandibular midline deviation a retrospective cross-sectional study was carried out, on growing patients with mixed and permanent dentition, who presented different types of malocclusions. They were selected from Bucharest and its surrounding area. Three study groups were formed: the first, with patients who had the mandibular midline shifted by less than 2 mm, the second, with patients in whom a deviation of the mandibular midline was recorded between 2-4 mm and the third with a deviation of more than 4 mm. In all the three study groups, the displacement of the lower dental midline was analyzed in different types of malocclusion according to Angle's classification, to which unilateral posterior crossbite (UPC) was added, taking into account sexual dimorphism.

Materials and Methods

The study was carried out on a heterogeneous group of 214 patients (134 females and 80 males), aged between 7 and 15 years (mean age of 9.5 ± 2 years), patients with malocclusion who presented for orthodontic treatment. The patients included in the study had a good general condition. They presented malocclusion, the group being selected from patients who went to the Bucharest Orthodontic Clinic for treatment, the investigations analyzed in this study being carried out before the start of orthodontic treatment. Patients who showed signs of craniofacial syndromes or malformations that may affect growth, those

with major facial trauma, with anodontia, supernumerary teeth or prosthetic crowns in the frontal area were excluded from the study group. Informed consent was obtained from the relatives of all patients before the start of the study. To carry out the study, approval was obtained from the Ethics Commission (protocol code PO-35-F-03, 28 March 2022). This research was conducted in accordance with the Declaration of Helsinki.

All necessary data were collected from the patients initial orthodontic records (photographs and casts). The diagnosis was established based on the data from the patients clinical record, corroborated with the data from the complementary investigations. The orthodontic casts were made of a high-quality plaster and positioned in the usual occlusion, clinically registered and reproduced on the study models using the occlusion registration material. The incisal papilla and the incisal median points (upper and lower) were used as landmarks to determine the upper and lower dental midlines (22,23,24). Shift of the mandibular midline to the right or left relative to the maxillary midline was assessed and measured on each patient's cast using a digital vernier caliper. The patient's age, gender, malocclusion diagnosis and range of movement of the mandibular midline were registered in the patient record. After the measurements were made, three study groups were formed, depending on the value of the displacement of the mandibular midline: a group with displacement less than 2 mm, the second with displacement between 2-4 mm and the third group with displacement more 4 mm. To avoid errors due to visual overload, no more than 20 investigations (photographs and casts) were analyzed per day, evaluated by the same investigator.

The patients included in the study were divided into five groups according to classes of malocclusion: four groups according to

Angle's classification: Class I, Class II/1, II/2 and Class III, and in group five were selected patients with unilateral posterior crossbite (UPC), who had at least two dental units in posterior crossbite.

Angle's classification, although frequently used at the present time, has been the subject of many discussions in the specialized literature, including only malocclusions that develop in the sagittal plane, the classification not taking into account the changes appearing in the transverse and vertical planes (25,26). However, it is a universally accepted system that reduces subjectivity and provides an easy way to classify malocclusions.

In order to calculate intra-observer reliability, each complementary investigation was evaluated twice, one month apart, by the same investigator.

For statistical data storage and processing, the Excel program from Microsoft Office Professional plus 2023 was used, to which the Real Statistics Resource package was added.

The statistical evaluation of the obtained data was carried out by means of descriptive statistics. Qualitative non-parametric data regarding the displacement of the mandibular midline to the right or left, the size of the displacement in millimeters, the types of malocclusion and the gender of the patients were presented in the form of number and percentage. The independent student *t*-test was used to compare the results obtained in the group of males and females, to notice if there are significant differences between the two groups.

Results

The values of the mandibular midline deviation obtained within the two series of measurements made at an interval of one month were analyzed statistically to check

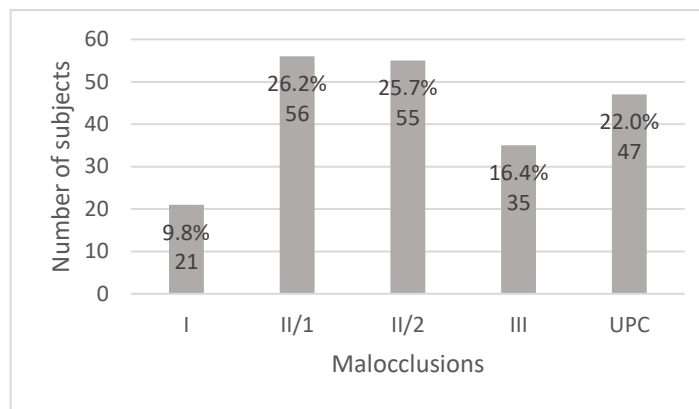
the intra-observer reliability. The *t-test* for paired measurements and the Lin's concordance correlation coefficient were used for this purpose. The *t-test* showed that there are no systematic errors (bias) in the measurements performed ($p=0.16$).

The correlation coefficient of the Lin concordance showed a substantial correlation between the two measurements, made at an interval of one month ($rc=0.97$), a fact that justifies the use of the measurements performed in the study.

Figure 1 shows the prevalence of the five classes of malocclusions analyzed within the study group. From the total number of subjects participating in the study (214), 21

percentage of 26.2% (N=56), Angle Class II/2 a percentage of 25.7% (N=55), Angle Class III a percentage of 16.4% (N=35), and with UPC-unilateral posterior crossbite a percentage of 22% (N=47).

Analyzing the percentage distribution by classes of malocclusions, it can be seen that within the studied group, more than half of the participants in the study fell into Angle Class II (51.9%), almost a quarter presented unilateral posterior crossbite UPC (22%), and the other quarter was divided between patients with Angle Class I and III malocclusions (26.2%). In the study, it was found that 75.7% of the patients with



patients had Angle Class I (9.8%), 56 patients Angle Class II/1 (26.2%), 55 patients Angle Class II/2

malocclusion had the mandibular midline displaced by more than 2 mm, and a quarter of them had the mandibular midline displaced by less than 2 mm.

Mandibular midline deviation	N (number)	% (percentage)
< 2 mm	52	24.3%
> 2 mm	162	75.7%

Table 1. The prevalence of patients with malocclusion in the study group depending on the mandibular midline deviation: < 2 mm and > 2 mm.

(25.7%), 35 patients Angle Class III (16.4%) and 47 patients with unilateral posterior crossbite UPC (22%).

Figure 1. Numerical and percentage distribution in the studied group according to the classes of malocclusion. Patients with Angle Class I anomaly in a percentage of 9.8% (N=21), Angle Class II/1 a

Taking into account the displacement of the mandibular midline according to the

classes of malocclusions, it was found that the highest percentage of patients had the displacement of the mandibular midline in the range of 2-4 mm with a percentage of 59.8%, followed by patients in the range of displacement values smaller than 2 mm with a percentage of 24.3%. The lowest percentage of 15.9% was appreciated in the range with mandibular midline displacement values greater than 4 mm.

According to the five types of malocclusion, in the range with values below 2 mm the highest percentage was appreciated, in Angle Class II/2 anomalies of 7.5% and Angle Class II/1 of 6.5%, and the lowest percentage of 1.4% in unilateral posterior crossbite (UPC).

In the interval with values of 2-4 mm of the displacement of the lower dental midline,

it was noted in the Class II/1 Angle anomaly (18.2%), followed by the percentage of unilateral posterior crossbite (UPC) of 15%. The lowest percentage was recorded in Angle Class I anomaly (4.7%).

In the third group, with the lower dental midline displacement value of more than 4 mm, the highest percentage was registered in unilateral posterior crossbite (UPC) (5.6%), followed by patients with Angle Class II/2 (5.1%). The lowest percentages were recorded in Angle Class III of 2.3% and an equal percentage of 1.4% in Angle Class II/1 and Angle Class I. It is worth noting the value of the percentage in Angle Class II/1 which in the previous interval had a value of 13.1%, and in this interval it decreased to 1.4% (table 2).

Table 2. The prevalence of patients by different types of occlusion according to the mandibular midline deviation.

Mandibular midline deviation	Type of occlusion	N (number)	% (percentage)
< 2 mm	CI I	8	3.7%
	CI II/1	14	6.5%
	CI II/2	16	7.5%
	CI III	11	5.1%
	UPC	3	1.4%
	Total	52	24.3%
2-4 mm	CI I	10	4.7%
	CI II/1	39	18.2%
	CI II/2	28	13.1%
	CI III	19	8.9%
	UPC	32	15%
	Total	128	59.8%
> 4 mm	CI I	3	1.4%
	CI II/1	3	1.4%
	CI II/2	11	5.1%
	CI III	5	2.3%
	UPC	12	5.6%
	Total	34	15.9%

Figure 2 shows the percentage distribution by malocclusion in the three groups based on the displacement of the mandibular midline. The highest percentage of lower dental midline displacement can be observed in the interval with values between 2-4 mm, of 18.2% in Angle Class II/1. A high frequency in all three analyzed groups was observed in Angle Class II/2 anomalies in the first interval (with the displacement of the lower dental midline

less than 2 mm) a percentage of 7.5%, in the second interval (with the displacement between 2-4 mm) a percentage of 13.1% and in the third interval (over 4 mm) a percentage of 5.1%. The lowest frequency could be appreciated in the three groups in Class I Angle anomalies in the first interval of 3.7%, in the second interval a percentage of 4.7%, and in the third a percentage of 1.4%.

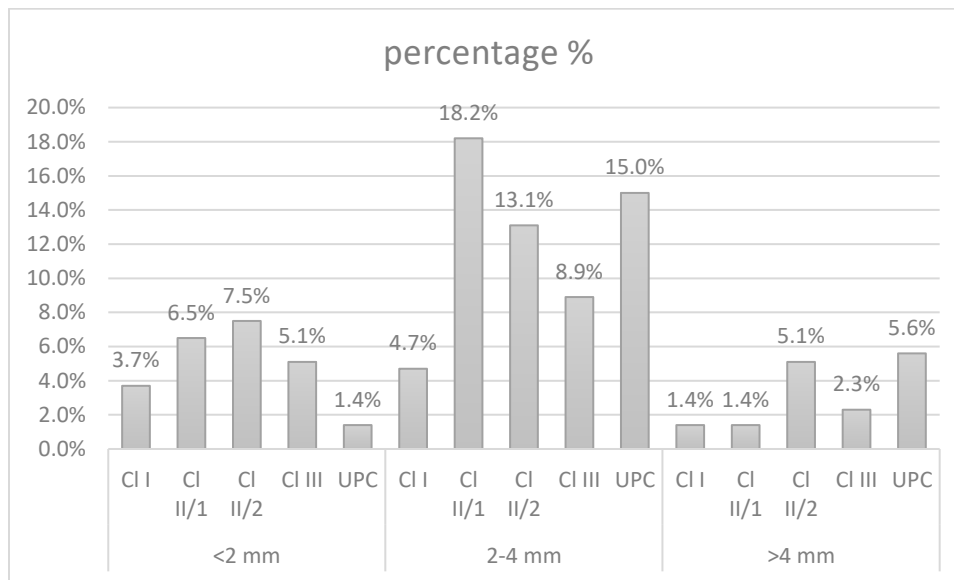


Figure 2. Percentage distribution by malocclusion according to the mandibular midline deviation. In the range smaller than 2 mm: Angle Class I a percentage of 3.7%, in Angle Class II/1 a percentage of 6.5%, in Angle Class II/2 a percentage of 7.5%, in Angle Class III a percentage of 5.1%, in UPC a percentage of 1.4%. In the range between 2-4 mm: Angle Class I a percentage of 4.7%, in Angle Class II/1 a percentage of 18.2%, in Angle Class II/2 a percentage of 13.1%, in Angle Class III a percentage of 8.9%, in UPC a percentage of 15%. In the range over 4 mm: Angle Class I a percentage of 1.4%, in Angle Class II/1 a

percentage of 1.4%, in Angle Class II/2 a percentage of 5.1%, in Angle Class III a percentage of 2.3%, in UPC a percentage of 5.6%.

Later, in the study, the group was divided into two subgroups, taking into account sexual dimorphism: a subgroup of males representing 37% (N=80) and a subgroup of females representing 63% (N=134) of the total number of patients (figure 3).

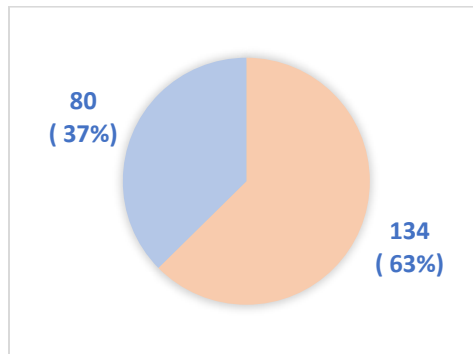


Figure 3. Numerical and percentage distribution by gender of the total number of patients (males 37%, N=80 and females 63%, N=134)

In the group of males, the highest percentage of the displacement of the lower dental midline was recorded in the interval with values between 2-4 mm, of 61.25%, followed by the percentage of 25% recorded in the interval with displacements of the lower dental midline of less than 2 mm and the percentage of 13.75% of the interval with displacements of the lower dental midline greater than 4 mm. In the group of females,

the highest percentage was also appreciated in the interval with values between 2-4 mm of 58.95%, followed by the percentage of 22.38% in the interval less than 2 mm and 17.16% in the interval more 4 mm. To Student *t*- test, the value of $p=0.98$ showed that there are no statistically representative differences between the two groups analyzed (table 3).

Table 3. The prevalence by gender, taking into account sexual dimorphism, according to the interval of mandibular midline deviation.

The degree of mandibular midline deviation	males		females	
	N	%	N	%
< 2 mm	20	25%	30	22.38%
2-4 mm	49	61.25%	79	58.95%
> 4 mm	11	13.75%	2.3	17.16%
No deviation	-	-	2	1.49%
Total	80	100%	134	100%
p-value	0.98			

Figure 4 shows the percentage distribution between males and females according to the mandibular midline deviation. In all three analyzed groups, it is observed that the prevalence is relatively similar within the two analyzed groups. The largest percentage difference between males and females was recorded in group three, with the displacement of the lower dental midline greater than 4 mm, the percentage of females (17.16%) being higher than that of males (13.75%).

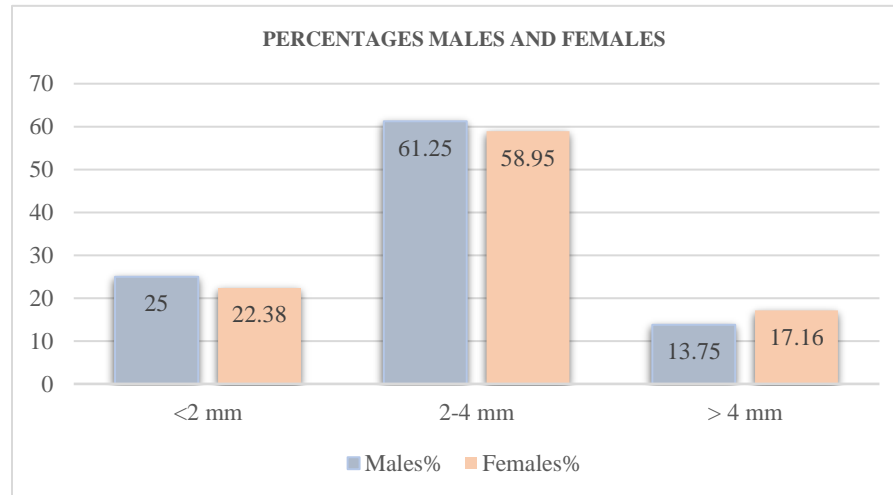


Figure 4. Percentage distribution by gender according to the displacement of the mandibular midline. Range less than 2 mm: males 25% and females 22.38%. The range between 2-4 mm: males 61.25% and females 58.95%. Range more 4 mm: males 13.75% and females 17.16%.

Discussions

In this study, a group of patients was statistically evaluated in which the prevalence of the mandibular midline deviation was determined in different types of occlusions and according to sexual dimorphism.

The displacement of the lower dental midline was most frequently observed in Angle Class II/1 (26.1%), Angle Class II/2 (25.7%), in unilateral posterior crossbite UPC (22%), and a lower percentage was observed in Angle Class III (16.3%) and Angle Class I (9.8%). From the collected data, a higher prevalence of mandibular

midline deviation in the range of 2-4 mm was observed in 59.8% of the total cases analyzed. Regarding the analysis of the batch according to sexual dimorphism, no statistically significant differences were recorded.

In accordance with various studies cited in the specialized literature, the displacement of the mandibular midline can be observed in all types of malocclusions, but most frequently can be noted in Angle Class II (12,27,29,31). In our study we appreciated the highest percentage in Angle Class II/1 (26.1%) and Angle Class II/2 (25.7%).

In an epidemiological study, conducted on a population group of 502 randomly selected

Iranian children aged 11-14 years, Borzabadi et al. assessed the prevalence of malocclusion, the occlusal traits that may occur and the gender distribution. They observed according to Angle's classification that the highest percentage of subjects was found in Angle Class I and the lowest in Angle Class II/2. Unilateral posterior crossbite UPC was encountered in a relatively low percentage (8.4%) of the investigated subjects. Movement of the lower dental midline greater than 2 mm was recorded in almost a quarter of patients, with statistically significant differences between males and females (28). Our study was performed on a smaller number of patients with malocclusion, nevertheless representative numerically and in terms of distribution. We noted the highest prevalence in Angle Class II/1 and Class II/2 anomaly classes, with half of the patients included in the study having Angle Class II anomaly. The displacement of the mandibular midline greater than 2 mm was recorded in 75.7% of the analyzed patients. Unlike the comparison study, no statistically significant differences were found between males and females. Comparatively, the results obtained in this study and that of Borzabadi et al. they may seem different, but we must take into account the fact that they conducted the study on a randomly chosen population, while in the conducted study subjects with malocclusions were analyzed, who requested orthodontic treatment, a fact that justifies the high value of the proportion of subjects with the deviation of the mandibular midline greater than 2 mm and the percentage value in terms of classification by classes of malocclusions. The different ethnic characteristics of the study participants must also be taken into account. An increased prevalence of Angle

Class II anomalies was frequently encountered in the Caucasian population, as evidenced by studies by Lewis, Harrison, Lux and Sonnesen (12,27,29,31).

Lux et al. carried out a similar study, on patients with malocclusion in the period of growth and development. They recorded the detailed information regarding the occlusal traits that can occur in different malocclusion and their prevalence taking into account sexual dimorphism. They orthodontically examined 494 German children with a mean age of 9 years. Similar to the current study, more than 50% of all subjects were recorded as having Angle Class II anomalies. Contrary to the current study, unilateral posterior crossbite UPC was recorded in a lower percentage (10.6% in Lux's study compared to 22% in the current study). The displacement greater than 2 mm of the mandibular midline was recorded in almost a quarter of the cases, different from the current study, where the same displacement was recorded in three quarters of the patients, certainly having an important impact on it and the characteristics of the Nordic typologies. Similar to the current study, no statistically significant differences were recorded between females and males. Even though our study was performed on a smaller group, the mean age was similar at 9.5 years (29).

In another epidemiologic study performed by random selection among the Colombian population, in different developmental stages of the dentition, Thilander et al. recorded mandibular midline deviation taking into account sexual dimorphism. Similarly, no statistically significant differences between males and females were revealed in this study (30).

In a study by Sonnesen et al. on 104 Danish children between the ages of 7-13, the

prevalence of malocclusion, the occlusal traits that may occur and the existing connection with disorders of the temporomandibular joint were followed. A percentage of 72% of patients with Angle Class II anomalies was assessed (the percentage of males in this class being higher than that of females), in unilateral posterior crossbite a percentage of 22% and in Angle Class III 1.9%. Lower dental midline displacement of more than 2 mm was found in 12.5% (31), in the same direction but more pronounced than the aforementioned German study. In the current study we recorded an increased percentage of patients with Angle Class II of 51.8%, in unilateral posterior crossbite obtaining a percentage similar to the above study (22%). We assessed the displacement of the lower dental midline greater than 2 mm in 75.7% of the analyzed cases.

Different methods of correcting mandibular midline deviation asymmetry have been discussed in the literature, but there are no definitive guidelines available in relation to the amount of displacement and the treatment plan that should be initiated and which is influenced by various factors such as age or malocclusion (32) or influencing the functions of the dento-maxillary apparatus. In clinical practice we encounter malocclusion associated with mandibular midline deviation that can increase the complexity and duration of treatment. As the orthodontic literature does not provide a protocol for the clinician in solving such problems, the orthodontist will have to analyze the etiology that determined the displacement of the mandibular midline, the way this displacement affects the occlusion and the need for therapeutic correction in the

planning stage of the orthodontic treatment (12).

The limitation of this study comes from the fact that it was carried out on a small sample, lacking homogeneity in terms of the composition of the group by age groups, gender and malocclusion.

Conclusions

Following the study, certain conclusions can be drawn:

- The prevalence of displacement of the mandibular midline with a value of more than 2 mm was observed in more than three quarters (75.7%) of the patients selected in the study group.
- It was appreciated that the greatest shift in terms of displacement of the mandibular midline was recorded in the range between 2-4 mm, so with degree of visibility and capacity to induce later temporomandibular joint pathology.
- Within the classes of malocclusions, with displacement of the mandibular midline in the range of 2-4 mm, the highest prevalence was recorded in the Angle Class II/1 (18.2%), in the unilateral posterior crossbite UPC (15%) and Angle Class II/2 (13.1%).
- Major displacement of the lower dental midline (with a value more 4 mm), as we would have expected from the beginning of the study, had the highest prevalence in unilateral posterior crossbite UPC (5.6%).
- The value of $p = 0.98$, obtained with the independent Student t -test, showed that from a statistical point of view there are no significant differences between females and males regarding the prevalence of

displacement of the mandibular
midline.

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